

Exhibit 1

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Innovator

Joseph Bates



Processors are very accurate. An MIT computer scientist says making them more error-prone could mean faster, more powerful computers

What's the square root of 10? If you had to do it in your head, you might say "a little more than three." Computers, unlike humans, don't do back-of-the-envelope calculations. They just crunch the numbers to the last requested decimal place.

Joseph Bates, however, thinks we'd be better off if we were to let computers make some mistakes. Bates, 55, a computer scientist at Carnegie Mellon and the MIT Media Lab, has designed a chip that does what computer engineers call "sloppy arithmetic," or guesstimating. Slightly inaccurate chips would be "much, much littler and much, much more efficient" than current chips, he says. Accurate calculation is a series of discrete tasks, such as carrying numbers when summing figures, that take up valuable processing power. By ignoring some of those tasks, Bates's chip, he predicts, would have something like 100,000 times the computing power of a traditional processor.

With an error range around 1 percent, Bates's chip wouldn't be wildly inaccurate:

One plus one might equal 2.02. In many applications, the resulting errors would either be imperceptible or automatically corrected. In digital photography and medical imaging, for instance, errors in the range of 1 percent would be invisible to the human eye. With other tasks, such as needle-in-a-haystack searches for particular images or sound files, Bates's chip could rifle through enormous databases, winnowing the list down to a few candidates for a more deliberate processor—or human being—to pick from. Bates foresees his chips being paired with traditional Intel-style chips for this purpose. The result: smartphones with the computing power of desktops, and desktops with the power of supercomputers.

While he hasn't fabricated a sloppy chip yet, Bates sees the engineering as fairly basic. There's a consensus among chip engineers that, as Bob Colwell, formerly the chief designer of Intel's Pentium chips, puts it, "whatever challenges are down the hardware path are probably overcome-able." Bates says several companies are looking at the technology, though nondisclosure agreements prevent him from naming them.

Bates's central research interest has always been artificial intelligence—like many researchers, he came to the topic by reading Isaac Asimov as a boy. Growing up in Baltimore, he skipped high school and went to Johns Hopkins University at 13. In some of his earliest research, he tried to get computers to think like creative human mathematicians, to do the equivalent of word problems rather than the abstract language of sets and equations. His turn to sloppy arithmetic follows in this vein: Part of its promise is that it could help computers act more like the human brain, which takes all sorts of shortcuts to answer problems. "By allowing things to be approximate, you're a lot closer" to achieving true artificial intelligence, says Bates. —Drake Bennett

Technology

cheaper machines, so they're instantly accessible to employees. Riverbed's gear quickly compresses the rest of the traffic, stripping out unseen bits such as e-mail headers. If someone in headquarters updates that sales presentation, only the new numbers are sent to the other offices—not the entire document.

Joseph Fusco, head of application development at **British Telecommunications'** U.S. services arm, says Riverbed's gear typically reduces the bandwidth necessary to run Office or Lotus Notes by more than 40 percent. "When people notice they can download a file in 20 seconds rather than 20 minutes, their eyes light up," says Fusco. The industry term for Riverbed's technology is WAN (for wide-area network) optimization. F5, for its part, makes more expensive machines that route traffic within the data centers, assigning computing tasks to those servers best prepared to handle them. F5 says its customers can get by with fewer servers, since the system makes sure each one is more fully utilized.

Fewer than one-fifth of companies have deployed application-acceleration technology, says Kennelly, so there's plenty of room for growth. "Every global company in the world will need this technology," he says. Riverbed had sales of \$499 million in the 12 months ended last September. That gives it a 40 percent share of the WAN optimization market, up from 28 percent in 2009.

What about **Cisco Systems**, the \$40 billion-a-year king of the networking-gear business? Although Cisco recently started loading its own application-acceleration technology for free on some of its routers, analysts such as Erik Suppiger of investment bank Signal Hill say Riverbed's tech edge will keep it in front. Kennelly professes no fear of Cisco. "Routers are a Rust Belt industry. They're still necessary, but it's not where the excitement is," says Kennelly. "We'll be one of the great tech companies for the next 100 years."

Networking analysts have grown used to such Muhammad Ali-like pronouncements. "Jerry's a bit of a loose cannon," says Suppiger. Kennelly retorts: "I'm not a loose cannon. I'm ebullient about our business. And I've been right all along." **B** —Peter Burrows

The bottom line Riverbed CEO Kennelly's soaring optimism has been backed up by the company's impressive performance.

Boy Genius ▶ Skipped high school and entered Johns Hopkins at age 13
Inspiration ▶ The fiction of Isaac Asimov led him to be an A.I. researcher
Potential ▶ "Sloppy" chips could make computers 100,000 times faster